APPENDIX C-3

Implementation: Putting the Technologies to Work

Whenever a new technology is being considered for use at a site, site operations and safety and health personnel should form a team to evaluate associated information in terms of identifying and resolving any issues that could affect the technology's suitability for implementation before the technology or process is selected or delivered. The onsite staff should have the option of rejecting a new technology or product if it poses risks or issues that are impractical to manage.

Prior to Delivery

The general operations management structure for implementation of the technology (including roles, responsibilities, objectives, and expectations) must be defined prior to delivery in clear, unambiguous terms. The operations team and its members should have documented roles and interfaces as well. Team members must understand and trust one another's judgment and actions; if necessary, team-building activities and adjustments should be performed. The objective is to have a functioning operations *team* to implement and use the technology or product.

The organization developing or manufacturing the technology or product should be required to provide all documentation available, and, depending on the complexity of the operations to be undertaken, operations personnel should work with the developer or manufacturer to identify and mitigate any hazards or issues that the developer or manufacturer may not have anticipated. Operations personnel will likely have site experience and may be able to share relevant site-specific information. If the product/process is tailored to a specific site, this interaction with the developer/manufacturer is particularly important.

Checklists for Safe Transitions

The operations team should develop a checklist to support the transition into the implementation phase. The transition from one phase of technology implementation to another can be extremely hazardous, as, for example, when a technology moves from construction through startup to operation,

or from operation through shutdown to maintenance or decommissioning operations. (See Figure C-6 for details on what should be included on a technology checklist.)

A transition also may occur as the result of an emergency, in which case a technology moves from operation to shutdown in an emergency shutdown mode. To mitigate the hazardous nature of such transitions, standard operating procedures (SOPs) should be developed to assist operators in moving a technology safely from one phase of implementation to another.

This checklist should include, at a minimum, a hazards analysis, a nuclear safety analysis, process descriptions, piping and instrumentation diagrams, electrical schematics and equipment classifications, design (or authorization) basis as they apply, design codes and standards that apply, safety systems (including emergency), operability parameters, information on supporting systems (including emergency), operability parameters, information on supporting systems (e.g., gantries or hoisting and rigging systems needed for construction, including subcontractors for specific instrumentation modules) and potential interactions with other activities near where the work is to take place (including whether they are trained to handle radioactively contaminated workers).

In addition, the operations team should assemble specific process/ product information, such as process flow diagrams; contact points for notification for operating limits (upper and lower) for equipment and processes; risk evaluations associated with changes in process, system, or subsystem; heating, ventilation, and air conditioning requirements for both processes and equipment; and operating environment for personnel.

Figure C-6. Technology checklist.

Integration With Existing Programs

During the implementation phase, the Technology Safety Data Sheet (TSDS) should be used as a tool to supplement and support the existing safety and health management system rather than as a stand-alone document. Every environmental remediation site is required to have some form of a Health and Safety Plan (HASP). Because of the commonality of elements, information in the TSDS could be used, for example, to address specific elements and requirements within the HASP.

Similarly, safety analyses performed for the TSDS might be useful in addressing other requirements such as those for Operational Readiness Reviews, permit applications, or the Superfund Amendments and Reauthorization Act (SARA) Title III.

Technology Safety Data Sheets

A TSDS is the central repository for hazard information pertaining to a specific technology. Ideally, each TSDS contains information accumulated throughout the entire process of a technology's development, commercialization, and implementation. Modeled after the material safety data sheet (MSDS) required by the hazard communication standard, the TSDS should be incorporated into a site's hazard communication or Hazardous Waste Operations and Emergency Response (HAZWOPER) informational program. The TSDS should be readily accessible to all workers in proximity to the technology. In addition, the TSDS can be used to inform safety and health professionals of potential hazards and to enhance the site-specific elements of the requisite HAZWOPER training (both initial and refresher courses).

Each TSDS has several component pieces or sections. These sections and their potential usefulness to safety and health professionals are described below. (An example of a TSDS is included in Part I of this document.)

TSDS Section 1: Technology Identity

The first section of a TSDS identifies the technology that is the subject of the sheet, and lists any alternate names that the technology is known by, the manufacturer's name and address, information and emergency contacts, and the TSDS originator's name and address. This last is important because, as information about hazards a technology may pose becomes available, it needs to be relayed to the originator for inclusion on the TSDS. The emergency contacts that are listed on the TSDS should also be included in the site-specific Emergency Response Plan (ERP).

TSDS Section 2: References and Applicable Regulations

Section 2 lists the TSDS's sources of information. References may include operating manuals, SOPs, maintenance procedures and schedules, and transition checklists and applicable regulations. The applicable regulations may include environmental as well as health and safety requirements (e.g., HAZWOPER). Should the onsite safety professional locate and cite additional sources of pertinent information, they should be conveyed to the originator of the TSDS.

TSDS Section 3: Process Description

The third section is a process description, which serves as an introduction to the technology described in the TSDS. Although the process description does not include hazard information, it does familiarize the practicing safety professional with the technology under discussion.

TSDS Section 4: Process Diagram

The process diagram affords the onsite safety professional an overview of the entire system of the technology under discussion. Images that realistically depict the technology are as valuable as diagrams. (See Figure C-7.)

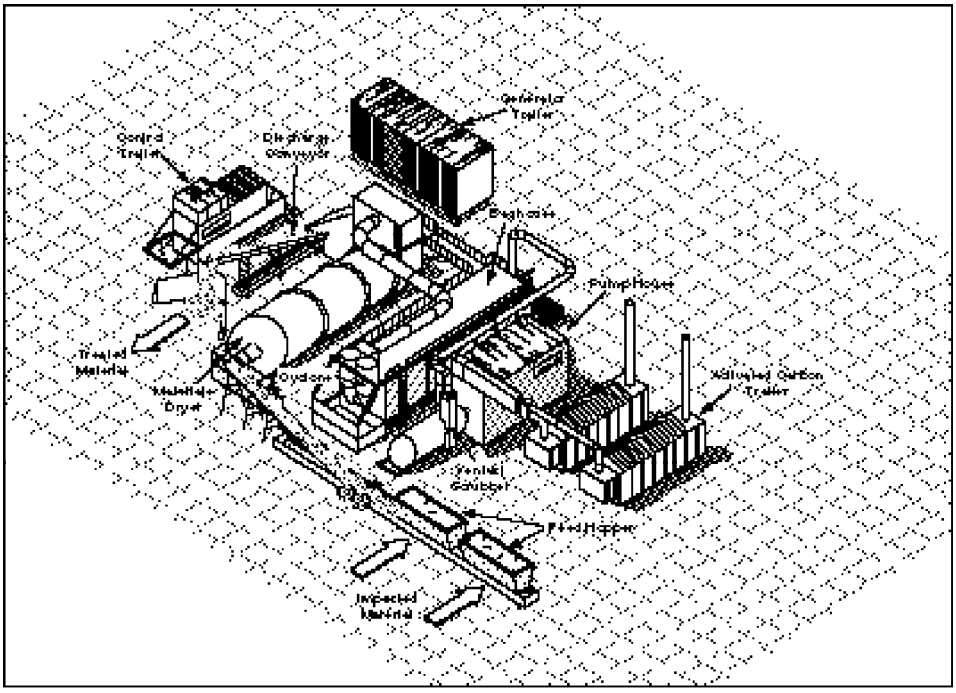

Figure C-7. Low-temperature thermal aerator.

TSDS Section 5: Contaminants and the Medium

A remediation operation may be prompted by the presence of contaminants in a waste stream at quantitative or qualitative levels sufficient to threaten public health. Ironically, however, the health threat posed to the workers who carry out the remediation operation may be higher than it would be to the surrounding population if no action were taken. In such a case, the potential occupational health risks associated with the waste stream must be understood and communicated to the

remediation workers, that is, the hazard of the substance involved must be conveyed to the worker. The risk is not always simple to gauge, since the hazards of a pure substance are far different from the hazards of that same substance dispersed throughout a medium like groundwater or soil.

TSDS Section 6: Associated Safety Hazards

The sixth section of the TSDS is a reiteration of the safety hazard matrix. (For more information on this matrix, see Appendix C-2.) The hazards associated with the technologies that have been identified are listed and ranked in terms of severity. A rating of one indicates that a hazard may be present but is not expected to be above background level. For example, electrical hazards may be present but pose no hazard specifically linked to the technology. A rating of two indicates that some level of hazard above background is known to be present. For example, the technology may require 220-volt service as opposed to 110-volt service. A hazard rating of three indicates a high hazard potential, and a rating of four indicates the potential for being immediately dangerous to life and health (IDLH).

TSDS Section 7: Associated Health Hazards

The seventh section of the TSDS is a reiteration of the health hazard matrix (see Appendix C-2). The health hazard rating is identical to that discussed above for safety hazards.

TSDS Section 8: System Safety Analysis

If an in-depth system safety analysis of the technology has been performed, the results are to be presented in this section and must be included in the site-specific HASP. Such a safety analysis should provide the site safety professional with excellent hazard identification information.

TSDS Section 9: Phase Analysis

A hazardous waste site is similar to a construction site in that it is constantly changing, moving from initial characterization, through remediation, and ultimately to closure. A remediation technology is similarily dynamic in nature, and involves four overall phases of implementation: construction, operation, maintenance, and decommissioning. Each phase imposes its own hazards, whose changing nature at a given site must be recognized by the site safety professional and communicated to workers through the site information program as they occur. Similarly, a HASP needs to reflect the dynamic nature of a site. The

hazards of each phase of a remediation technology's implementation are identified in this phase.

TSDS Section 10: Technology-Specific Programmatic Elements

This section of the TSDS is written specifically for the onsite safety professional. If the technology to be implemented at a site requires special program elements, guidance is included here on how to develop effective elements for inclusion into the safety and health program and site-specific HASP. For example, if the technology to be implemented requires a lockout/tagout program, this section of the TSDS identifies that need, offers guidance on how to develop an effective program, and highlights any peculiarities that must be addressed.

TSDS Section 11: Comments and Special Considerations

This section is reserved for the originator and other contributors to insert information not easily categorized and not elicited in other sections of the TSDS. Clearly, this information should be reviewed by the onsite safety professional and any appropriate actions taken.

TSDS Section 12: Case Studies

This section is used to document in narrative form the experience of implementing a given technology, resulting in the creation of a "case" for study. Onsite safety professionals should review TSDS case studies to learn from the experiences of other professionals who have implemented the technologies previously.

Onsite safety professionals should send to the preparer of a TSDS any information they have that could be used to create a case study.

Regulatory Requirements

Anticipating the complexity, ever-changing nature and hazard potential of technologies associated with hazardous waste site remediation, OSHA's HAZWOPER Standard, 29 CFR 1910.120, specifically requires companies to establish programs to ensure the safe introduction of new technologies onsite. HAZWOPER paragraph (o), which discusses new-technology programs, applies to new technologies used in personal protective equipment (PPE) as well as to those used in remediation. Before implementation of a new technology can occur on a large scale, employers or their representatives must assess the effectiveness of the associated methods, materials, or equipment in enhancing employee protection.

The OSHA HAZWOPER Standard requires employers at uncontrolled hazardous waste sites to develop and implement informational programs to inform employees, contractors, and subcontractors of the nature, level, and degree of exposure likely as a result of engagement in hazardous waste operations.[1]

Hazardous waste is exempt from the Hazard Communication Standard because of the labeling requirements to which it is subject under the Resource Conservation and Recovery Act (RCRA). Nevertheless, an information program on hazardous waste might include postings on a safety bulletin board or company newsletter. Any hazardous materials used on a site, other than in the waste stream, should be addressed in a site hazard communication program, and should be described on MSDSs that are readily available to employees.

HAZWOPER requirements for responding to emergencies caused by the uncontrolled release of hazardous substances are presented in the HAZWOPER Standard. This Standard identifies requirements for emergency responses to the uncontrolled release of hazardous substances in three separate paragraphs:

- At hazardous waste sites and the sites of cleanup operations; see paragraph (l);
- At hazardous waste treatment, storage, and disposal facilities; see paragraph (p)(8); and
- At the site of any other type of operation where hazardous substances are released; see paragraph (q).

Although the requirements vary slightly depending on the applicable paragraph, those with the broadest application and most detailed specifications are found in paragraph (q), which applies to all industries subject to the potential for emergencies caused by uncontrolled releases of hazardous substances.

The key to compliance with the emergency response provisions in the HAZWOPER Standard is development of a comprehensive emergency response plan (ERP) as required in 29 CFR 1910.120, paragraph (q)(1) and as further defined in (q)(2), which lays out specific elements the plan must contain. Designers and manufacturers of technologies should be familiar with these specific elements to understand the

[1] Health and Safety Plan Guidelines, DOE Limited Standard, DOE-EM-STD-5503-94, U.S. Department of Energy, Washington, DC, December 1994.

complexity of response operations and the value of information derived from the technology development and system safety analysis process.

In addition to responsibilities under OSHA's HAZWOPER Standard, employers have obligations under SARA Title III to coordinate with local emergency planning committees (LEPCs) in order to establish adequate emergency responses for their facilities. This may require an employer to forward an entire set of MSDS from a facility, if the LEPC requests it. The logical sequel to having to meet these requirements is that industries will advise their LEPCs of the presence and associated hazards of the technologies they use. This may be done by forwarding TSDSs, emergency procedures, SOPs, and other information to the LEPCs.

Emergency Response Considerations

No matter how well designed, technologies have the potential to fail. When a technology is designed to treat media contaminated with hazardous materials, its failure may result in the uncontrolled release of a hazardous substance, energy, or debris that endangers the health or safety of those working in the vicinity. Promptly taken corrective actions may stabilize the situation and allow control to be reestablished safely.

Technology developers and manufacturers must address the potential for their technologies to fail and they must inform users of the procedures to follow, if failures occur. Such information and procedures can be very simple. For example, it has been reported that when an overpressurized vessel at the Union Carbide plant in Bhopal, India, released deadly gas in 1982, it is possible that many lives could have been saved with little additional effort. In this case, if people in the vicinity had breathed through water-soaked towels, they might have been able to counteract the effects of the methyl isocyanate gas that was released into the air and reduce or eliminate its harmful effects.

Emergency response information from technology developers and manufacturers should cover a broad variety of emergencies that could result from the failure of one or more technology processes or components. Moreover, this information is needed in a format that is easy to understand and capable of being used by site personnel and workers.

One important use of this information is for site managers to prepare a site-specific ERP. This plan must reflect not only the unique hazards and risks associated with use of the technology, but also the specific needs of local fire and police departments and hazardous materials (HAZMAT) and

emergency response personnel. Although preparing this plan is the responsibility of the site manager and not the technology developers, the information used to develop the plan must be accurate and understandable if it is to be used in pre-incident emergency response planning. One possible tool for technology developers to use is an Emergency Procedures Safety Data Sheet (EPSDS). This tool would serve as a means for technology developers to provide a profile of emergency preparedness and response planning issues that need to be incorporated into a site's ERP.[2]

The intent of the EPSDS is to facilitate the transfer of appropriate emergency preparedness and emergency response information from technology developers to site managers for use in preparing a site-specific ERP. If the potential for failure is considered at the design stage and appropriate information is directed to the right people, the consequences of emergencies at sites using innovative cleanup technologies are less likely to jeopardize the safety and health of workers.

Emergency Response Plan Elements

A discussion of specific elements and procedures for developing the individual components of an ERP is provided in Part II of this document, with particular emphasis on considerations for designers and developers of hazardous waste treatment technologies. The listing of these elements is taken directly from the HAZWOPER Standard requirements for emergency response, as described in 29 CFR 1910.120, paragraphs (q)(1) and (q)(2).

[2] A preliminary review copy of a representative Emergency Procedures Safety Data Sheet is still being developed, but it should be available for review and discussion at the DOE and NIEHS technical workshop on November 30 and December 1, 1995.